Low Voltage Electrolyte-Gated Transistors and Circuits for Printed Electronics

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Integration of electronic circuitry onto flexible, stretchable substrates is motivated by applications in roll-up displays, wearable biosensors, and electronic skins, for example. One approach to flexible electronics employs state-of-the-art liquid phase printing methods to pattern electronically functional inks onto paper or plastic. This talk will begin with a brief overview of basic challenges for printed electronics and then will focus on a low voltage switch called an electrolyte-gated transistor (EGT) that can be printed from liquid inks to make simple circuits on flexible substrates. In EGTs, a high capacitance gel electrolyte based on ionic liquids and block copolymers is employed as the gate insulator in order to achieve very low voltage operation; it will be shown that a variety of different semiconductors can be employed in the channel. Advantages of EGTs include inherent printability, sub-2V operation, extremely high transconductance, high ON/OFF current ratios, 10 μs switching speeds, and good resistance to bias stress and mechanical deformation. These advantages must be balanced against potential disadvantages such as dielectric loss in the gate electrolyte and increased parasitic capacitance. These issues will be discussed in detail and some demonstrator circuits will be described. A portion of the talk will be spent describing the properties of the gel electrolytes, known as ion gels, used as gate insulators. Because of their high ionic conductivity (up to 10 mS/cm) and mechanical robustness, ion gels may have applications in other areas besides printed electronics.